(12) UK Patent Application (19) GB (11) 2 354 022 (13) A

(43) Date of A Publication 14.03.2001

(21) Application No 9921136.9

(22) Date of Filing 07.09.1999

(71) Applicant(s)
Antech Limited
(Incorporated in the United Kingdom)
Unit 7, Newbery Centre, Airport Business Park, EXETER, EX5 2UL, United Kingdom

(72) Inventor(s)
Toni Miszewski

(74) Agent and/or Address for Service
Hillgate Patent Services
No 6 Aztec Row, Berners Road, Islington, LONDON, N1 0PW, United Kingdom

(51) INT CL[7]
E21B 47/01

(52) UK CL (Edition S)
E1F FHB FHU

(56) Documents Cited
WO 95/16849 A WO 87/02095 A US 5320169 A
US 4735264 A US 4628995 A

(58) Field of Search
UK CL (Edition R) E1F FHB FHH FHJ FHK FHU
INT CL[7] E21B 47/01
Online: EPODOC, WPI, JAPIO

(54) Abstract Title
Gauge carrier with separate instrument housing

(57) A gauge carrier comprises a main body (60) and a separate instrument housing (30), including a gauge (40), where the instrument housing is securable to the main body. The main body includes a handling region (45) suitable for being handled by rig tongs, where in use, the instrument housing is attached along the handling region subsequent to the body being handled. Preferably the handling region is located centrally along the length of the body and the body may include at least one protective region (34, 35) having a larger cross section than the majority of the main body.

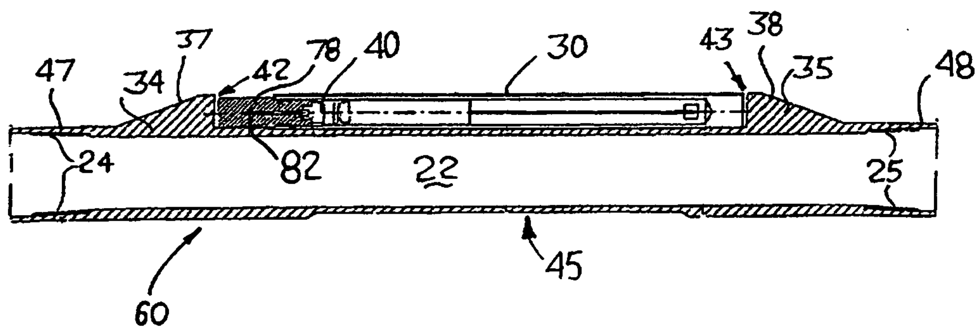

Fig. 2

GB 2 354 022 A

1/3

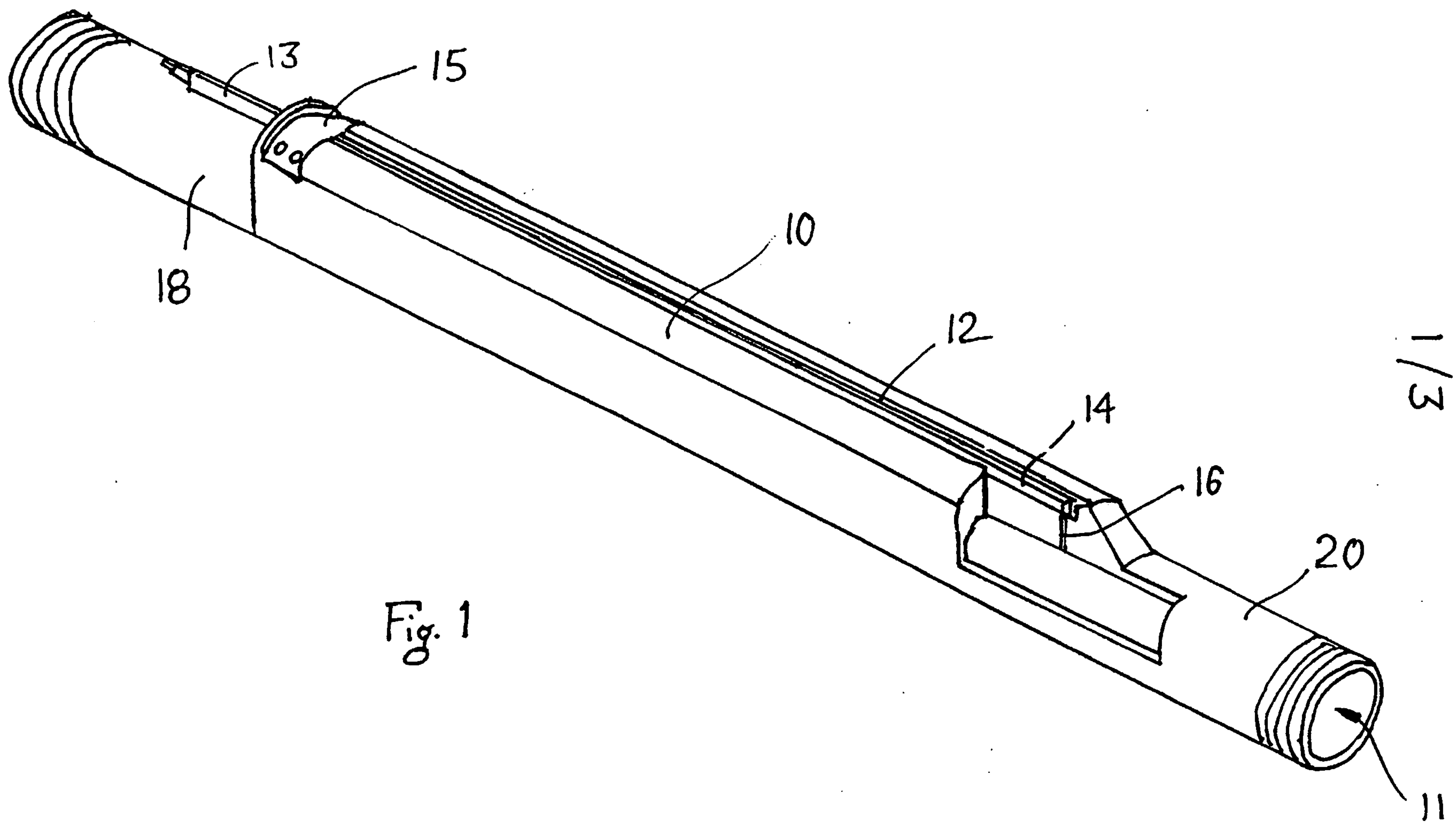

Fig. 1

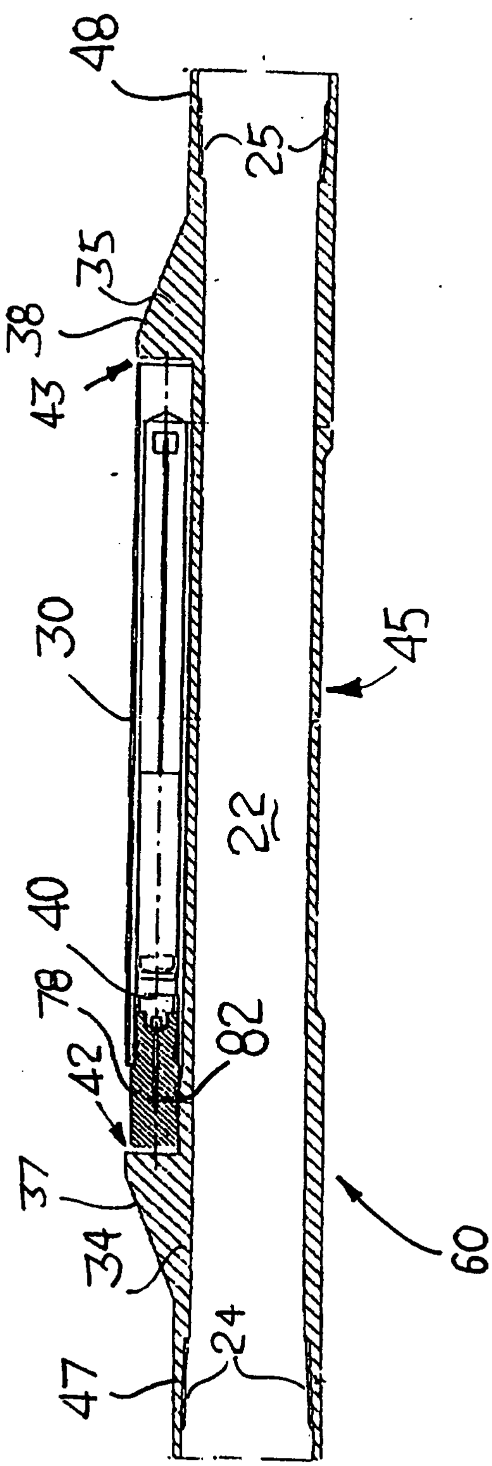

Fig. 2

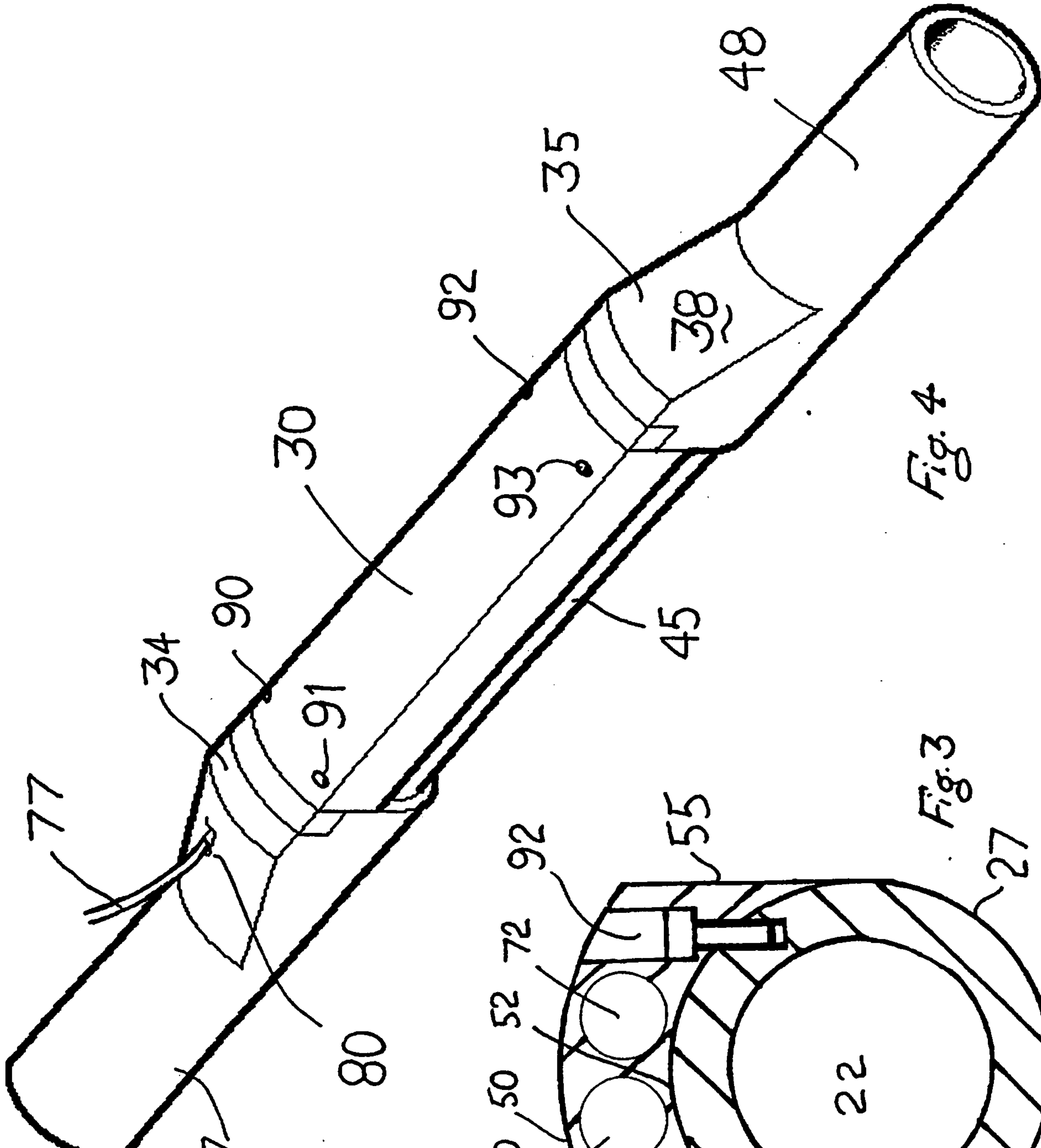

Fig. 4

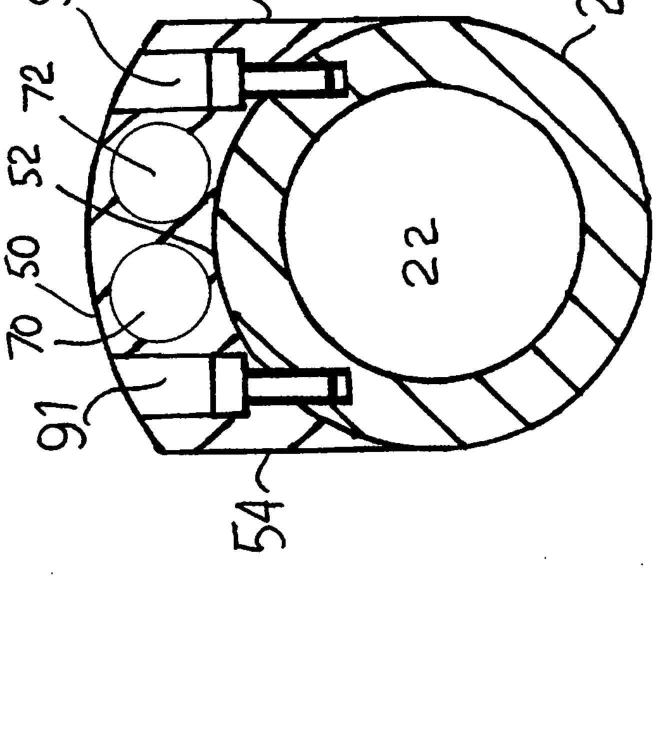

Fig. 3

2354022

Carrier Assembly

This invention relates to carrier assemblies, that is, assemblies for carrying instrumentation down boreholes and the like.

Pressure gauge carriers are often incorporated into drill strings so that the pressure within the drill string may be monitored. A conventional pressure gauge carrier is generally tubular, having a bore similar to that of the drill string.

A known way of making such a pressure gauge carrier is to machine the shape from a solid bar of metal. Such a gauge is shown in figure 1. An inner bore 11, corresponding to the drill string bore, is drilled axially.

The bar is progressively machined at each end region to produce a central saddle 10 (that is, central when considering the pressure gauge carrier lengthways), the outer boundary of the cross section of the saddle being defined by a lower curve and an upper curve, joined by two flat sides opposite and parallel to each other.

The two curves have a radius of curvature limited by the well casing. The axial bore runs close to the lower curve, so that the thickness between the bore and the lower curved surface corresponds approximately to the wall thickness of the drill string.

At either end of this central saddle 10, the pressure gauge carrier extends axially as tubular portions 18,20, the end regions of the central saddle 10 being chamfered down to meet the tubes' diameter. The tubes have the same thickness as the thickness between the bore and the lower curved surface of the central saddle. At each end of the pressure gauge carrier, the outer surface of the tube is threaded to be received by a drill pipe.

An axial groove 12 is machined from the upper curve of the saddle, the depth of the groove, considered in cross section, descending radially towards the centre of the axial bore.

The pressure gauge 14, comprising a pressure gauge sensor, and its associated electronics, is arranged in a generally linear fashion. The pressure gauge is encased in a sheath to protect the components from the hostile environment. The electronics thus sheathed are laid in the groove in the saddle, the length of the groove being such that the electronics run right the way along. The pressure gauge sensor is situated at the end of the line of electronics (that is, the linear arrangement of circuitry associated with the pressure gauge sensor), at the closed end of the groove. A channel 16 radially communicates between the axial bore and the groove at the closed end.

At the one end of the groove 12 the electronics and sheath terminates in a connector which is attached to a cable 13, the cable supplying the pressure gauge with any power or commands it needs, and allowing the transmissions of data back to the surface. Somewhat short of this end of the groove, a plate 15

is clamped over the groove to secure the pressure gauge. The central saddle may feature a recess to accommodate the plate flush with its surface.

To incorporate the pressure gauge carrier into the drill string, rig tongs grip the tubular portions 18,20 of the pressure gauge carrier, and then carry the pressure gauge carrier to the drill string, and introduce one end of the pressure gauge carrier to the open end of the drill pipe uppermost in the drill string. The pressure gauge carrier is rotated by the rig tongs so that the pressure gauge carrier and the drill pipe are securely joined by their respective threads. The rig tongs are designed to grip a standard circumference (corresponding to the diameter of the drill pipe sections) with the required force. The tubular portions of the pressure gauge provide regions of standard circumference on the pressure gauge which can withstand the grip of the rig tongs.

The pressure gauge carrier is an expensive piece of equipment. It involves a lot of machining from the original solid block of metal.

It is an object of the present invention to provide a pressure gauge carrier which is economic to manufacture, which has good mechanical properties, and which is convenient to install.

According to one aspect of the invention there is provided a gauge carrier comprising a main body capable of incorporation into a suitable drill string, and a separate instrument housing including a gauge, the instrument housing being securable to the main body.

Preferably the main body includes a handling region suitable for being handled by rig tongs and the like, wherein the instrument housing may be attached substantially along that handling region subsequently to its being handled. Preferably the handling region is located substantially centrally along the length of the main body.

Preferably the main body includes at least one protective region having a larger cross section than the majority of the main body, and preferably two situated either side of the handling region. Preferably the cross section of the protective region or regions correspond to the thickness of the instrument housing.

According to another aspect of the present invention, there is provided a method of incorporating a gauge carrier as herein defined into a drill string, including;

joining an end of the main body to a drill pipe section, and

thereafter attaching the instrument housing to the main body.

According to a further aspect of the present invention, there is provided a gauge carrier capable of incorporation into a suitable drill string including a gauge whose components are generally arranged in series, the gauge being housed in at least two substantially parallel chambers, and the gauge including a 180° bend in its arrangement. Preferably the chambers are axial bores.

According to a still further aspect of the present invention, there is provided a main body, an instrument housing, or a gauge as herein defined.

The invention will now be described, by way of example, and with reference to the accompanying drawings, of which;

Figure 1 is a prior art pressure gauge carrier in perspective view with a cut-away portion,

Figure 2 is a longitudinal section of a preferred embodiment of a pressure gauge carrier,

Figure 3 is the instrument housing and narrowed region of the pressure gauge carrier in cross section, and

Figure 4 is a perspective view of the pressure gauge carrier.

Referring to figures 2 to 4, the pressure gauge carrier embodying the present invention comprises a main body 60 including a narrowed region 45, an instrument housing 30, and a pressure gauge 40.

Considered in cross section, the main body is generally tubular, having a circular bore 22, and an generally cylindrical outer surface which is of generally similar diameter to the production tubing with which it is intended to be joined with. At each end a thread 24,25 may be provided upon the inner

surface of the bore corresponding to the thread on the male ends of the drill pipes with which the carrier is to be attached to.

Somewhat in from each end, the main body widens to form two protective shoulders 34,35. At the shoulders' greatest extent, the cross section comprises the lower curve of the main body, two parallel sides, and an upper curve, which may, as shown here, have a greater curvature than the curvature of the outer diameter of the tubular parts of the main body. Each shoulder has a chamfered flat surface 37,38 down to its respective end of the main body. Each shoulder then extends a short distance along the length of the main body, before ending with a flat surface perpendicular to the axis of the main body.

The outer diameter of some or all the region between the shoulders 34,35 may narrow somewhat as shown in the figure. The diameter over this narrowed region 45 has a smaller diameter than that of the rest of the main body, so that the curvature of the at this region is more similar to the outer curvature of the drill pipe. In this way, the region is better adapted to being gripped by the rig tongs, as described below in more detail.

To aid the introduction of the drill pipe ends to the main body, one or both ends of the main body may extend outwards in the form of tubular portions 47,48, the tubular portions' wall thickness tapering somewhat, as shown in the figures. As the tubular portions are not necessary for the handling of the main body by the rig tongs, the tubular portions, if present, need not be so long as in the case of the prior art pressure gauge carrier. Such tubular portions could even be threaded on the outer diameter to be accepted in a male

fashion by female drill pipe sections, or indeed the main body could have one male connecting end and one female connecting end.

The instrument housing 30 sits on the top of the main body, between the two shoulders 34,35. Referring to figure 3, the instrument housing has a uniform cross section, the cross section having a curved base 52 which rest upon the outer diameter 27 of the narrowed region of the main body, two flat parallel sides 54,55, and an upper curve 50. The curvature of this upper curve is of similar radius of curvature to that of the upper curve of the shoulder at its full extent. When placed on top of the main body between the shoulders, the instrument housing's upper curve 50 and two sides 54,55 lie inside or at least flush with the shoulders' upper curves and sides. The instrument housing 30 is therefore hidden behind the shoulders 37,38 when the carrier is viewed end on, so that the shoulders protect the instrument housing as the drill string advances through the borehole.

The instrument housing 30 also includes two axial bores 70,71, running side by side in the instrument housing, each an equal distance from the top surface 32 of the main body. These bores are drilled out along the entire length of the instrument housing, and at one end of the instrument housing, the wall between the bores is removed so that they communicate.

The instrument housing is fitted in the region between the shoulders, and fastened to the main body, for example by four screws at each corner 90,91,92,93 when considered in plan. The instrument housing is somewhat shorter than the distance between the opposing faces of the shoulders, so that

there is enough room to fit a cable connector to the line of electronics. Fitting the electronics in a linear arrangement is very convenient, firstly as circular bores are easier to form than other shapes, and secondly because the electronics of various instruments is usually supplied in a standard linear form to enable interchangability between instruments and their carriers.

The pressure gauge's line of electronics is threaded through the first bore, turned back on itself and then threaded through the second, so that the line of electronics doubles back at the communicating region of the instrument holder where the wall between the bores has been removed. At this end (hereinafter termed the switch-back end) of the instrument holder, the axial bores are sealed so that they are no longer open to the outside.

At one end of the line of electronics, (at the end of the instrument housing opposite the switch-back end and hereinafter termed the connector end) a connector (not here visible) is detachably attached, this connector in turn connected with a cable 77 that supplies any necessary power to the pressure gauge, and carries the data that the gauge collects back to the surface. The socket which accepts the connector fits firmly in one of the axial bores at the connector end of the instrument housing, sealing the aperture. The shoulder at the connector end includes a hole 80 to allow the cable to pass through it.

The line of electronics also ends with a plug 78 at the connector end of the instrument housing, extending somewhat through the other aperture. This plug seals the aperture, so that the chamber contained the electronics is

completely sealed off from the outside environment. A small channel 82 connects the main body's bore, via the plug, to the pressure gauge sensor.

In order to install the pressure gauge carrier, the main body (without the instrument housing attached) is picked up by the rig tongs, which grip the main body at the narrow region 45 between the two shoulders, and place the main body upon a drill pipe so that a free end of the drill pipe is inserted into the bore of the main body. The rig tongs then rotate the main body so that it is securely joined to the drill pipe. Once securely joined, the rig tongs are removed from the main body.

The instrument housing, with the pressure gauge installed, is now attached to the main body. The cable 77 is threaded through the hole 80 in the uppermost shoulder, and joined by its connector to the pressure gauge.

The next drill pipe section is introduced to the free end of the pressure gauge carrier, and tightened in the conventional manner using rig tongs. If desired the fitting of the instrument housing may be postponed until subsequent drill pipe has been fitted.

Since the instrument housing and pressure gauge are only fitted after the main body is attached to the drill string, the danger of the pressure gauge being damaged is greatly reduced.

The main body may also be handled by the region between the shoulders prior to being added to the drill string, for example in the workshop, and whilst being brought to the rig.

The pressure gauge carrier may be a much shorter length, and therefore require far less machining, than a conventional pressure gauge carrier.. There are several reasons for this. Since the pressure gauge is not fitted to the main body until after the main body has been installed in the drill string, the rig tongs may grip the main body at any point between the shoulders. The tubular portions extending from the prior art pressure gauge carrier, by which the pressure gauge carrier is carried, are not then necessary. For this reason the main body ideally fits in a female fashion to introduced drill pipe sections.

A length saving also results from turning the line of electronics back upon itself. The instrument housing is about half the length of the electronics disposed along the groove of the prior art pressure gauge carrier.

The instrument housing 30 is stronger than known instrument housings of the same diameter, as the double bore ensures a greater wall thickness between the bores 70,71 and the upper curve 50 than would be the case for a single bore.

These savings in length allow a smaller block of metal to be used to form the pressure gauge carrier, and consequently much less machining is required. This represents a considerable cost saving over machining a longer pressure gauge carrier.

The pressure gauge itself is much less likely to be damaged, as it is fitted only after the main body has been incorporated into the drill string. The pressure gauge is also protected to a greater extent by the greater structural strength of the instrument housing over the corresponding portion of the prior art pressure gauge carrier. By sacrificing some of this additional structural strength, the pressure gauge carrier could be made to a smaller outer diameter.

Specific features disclosed herein could be combined with other features of prior art gauge carriers in many permutations. For example, the parallel bores of the instrument housing could be bored directly into an integral pressure gauge carrier of the prior art type. Rather than bores, the gauge could be housed in two parallel channels machined out of the pressure gauge carrier. The principles disclosed herein could be applied to any similar instrument carriers with the necessary adaptations.

CLAIMS

1. A gauge carrier comprising a main body capable of incorporation into a suitable drill string, and a separate instrument housing including a gauge, the instrument housing being securable to the main body.

2. A gauge carrier according to the previous claim, wherein the main body includes a handling region suitable for being handled by rig tongs and the like, wherein the instrument housing may be attached substantially along that handling region subsequently to its being handled.

3. A gauge carrier according to either previous claim, wherein the handling region is located substantially centrally along the length of the main body.

4. A gauge carrier according to any previous claim, wherein the main body includes at least one protective region having a larger cross section than the majority of the main body.

5. A gauge carrier according to any claim 4, wherein the main body includes two protective regions situated either side of the handling region.

6. A gauge carrier according to either claim 4 or 5, wherein the cross section of the protective region or regions correspond to the thickness of the instrument housing.

7. A method of incorporating a gauge carrier according to any previous claim into a drill string, including;

joining an end of the main body to the end of a drill pipe section, and

thereafter attaching the instrument housing to the main body.

8. A gauge carrier capable of incorporation into a suitable drill string including a gauge whose components are generally arranged in series, the gauge being housed in at least two substantially parallel chambers, and the gauge including a bend in its arrangement.

9. A gauge carrier according to claim 8, wherein the chambers are axial bores.

10. A main body according to any of claims 1 to 7.

11. An instrument housing according to any of claims 1 to 7.

12. A gauge according to any previous claim.

13. A main body substantially as herein described and illustrated.

14. An instrument housing substantially as herein described and illustrated.

15. A gauge substantially as herein described and illustrated.

16. A gauge carrier substantially as herein described and illustrated.

17. A method of incorporating a gauge carrier into a drill string substantially as herein described and illustrated.

18. Any novel and inventive feature or combination of features specifically disclosed herein within the meaning of Article 4H of the International Convention (Paris Convention).

CLAIMS

1. A gauge carrier comprising a main body capable of incorporation into a suitable drill string, and a separate instrument housing including a gauge, the instrument housing being securable to the main body, and the main body including a handling region suitable for being handled by rig tongs and the like, wherein the instrument housing may be attached substantially along that handling region subsequently to its being handled.

2. A gauge carrier according to claim 1, wherein the handling region is located substantially centrally along the length of the main body.

3. A gauge carrier according to either previous claim, wherein the main body includes at least one protective region having a larger cross section than the majority of the main body.

4. A gauge carrier according to claim 3, wherein the main body includes two protective regions situated either side of the handling region.

5. A gauge carrier according to either claim 3 or 4, wherein the cross section of the protective region or regions correspond to the thickness of the instrument housing.

6. A method of incorporating a gauge carrier according to any previous claim into a drill string, including;

joining an end of the main body to the end of a drill pipe section, and

thereafter attaching the instrument housing to the main body.

7. A gauge carrier capable of incorporation into a suitable drill string including a gauge whose components are generally arranged in series, the gauge being housed in at least two substantially parallel chambers, and the gauge including a bend in its arrangement.

8. A gauge carrier according to claim 7, wherein the chambers are axial bores.

9. A main body according to any of claims 1 to 6.

10. An instrument housing according to any of claims 1 to 6.

11. A gauge according to any previous claim.

12. A main body substantially as herein described and illustrated.

13. An instrument housing substantially as herein described and illustrated.

14. A gauge substantially as herein described and illustrated.

15. A gauge carrier substantially as herein described and illustrated.

16. A method of incorporating a gauge carrier into a drill string substantially as herein described and illustrated.

17. Any novel and inventive feature or combination of features specifically disclosed herein within the meaning of Article 4H of the International Convention (Paris Convention).

The Patent Office

INVESTOR IN PEOPLE

Application No:	GB 9921136.9	18	**Examiner:**	Joanne Pullen
Claims searched:	1-7, 16 & 17		**Date of search:**	1 February 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): E1F FHB, FHH, FHJ, FHK, FHU

Int Cl (Ed.7): E21B

Other: Online: EPODOC, WPI, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO 95/16849 A1	(BAROID TECHNOLOGY INC.) See figure 1 and page 7 line 25-page 8 line 1.	1, 4, & 7
X	WO 87/02095 A1	(P. W. WIERZBA) See figures 1 and 2	1 & 7
X	US 5320169 A	(PANEX CORPORATION) See figure 2 and column 2 line 50 - column 3 line 45	1
X	US 4735264 A	(HALLIBURTON COMPANY) Claim 3	1
X	US 4628995 A	(PANEX CORPORATION) See figure 1 and column 2 lines 19-51.	1 & 7

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.